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ABSTRACT

Computers, telecommunications, and interactive cable are among the many technologies that have immense potential to help schools reach higher standards. To realize this potential, policymakers and educators must coordinate technology purchases and uses with articulated learning standards and curriculum goals. Governors can play a valuable role in this process by helping to ensure that all schools have access to technology and use it to support high quality instruction. Studies on the use of technology for classroom instruction point to a range of benefits, including increases in student achievement levels. Technology also enables teachers to enrich student learning experiences by bringing the outside world into their classrooms and obtaining instructional resources that go beyond what a single school or district can provide. Voice mail, electronic mail, and video can increase parents' involvement in their children's education. Technology can provide educational equity by providing access for all schools to information and high-quality learning experiences. By facilitating communication, providing greater access to information, and saving time, administrative uses of technology can support school improvement and in some cases cut costs. State and district officials must plan for technology costs which go beyond one-time hardware and software expenditures. Financial support must come from reallocation of existing resources and from creative public-private partnerships. (AEF)

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Issue Brief

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Technology and Education Standards

Technology can be a powerful ally in the quest to reform schools. Ambitious academic standards for students call for new ways of teaching and new ways of organizing schools to support higher performance. Higher standards mean that all students need to master basic skills as well as become adept at thinking analytically, solving problems, and communicating clearly. In addition, educators and business leaders agree that students must be able to use a variety of technologies if they are to succeed in the workforce of the twenty-first century.

Computers, telecommunication, and interactive cable are among the many technologies that have immense potential to help schools reach higher standards. Yet, the sad truth is that schools are technologically impoverished. They have not even caught up with the computer revolution of the last decade, let alone become part of the telecommunications revolution of the 1990s.

Equally disturbing is the fact that when technology is present in schools, it is all too often used with styles of teaching that fail to maximize its full potential. This is not surprising. Few teachers or administrators receive adequate preparation during their preservice or inservice training about how to integrate technology into classrooms and schools.

To realize the potential of technology to support high performance, it is of paramount importance that policymakers and educators rethink teaching and learning together with technology purchases. Governors, working with educators, parents, business leaders, and communities, can play a valuable role in this process by helping to ensure that all schools have access to technology and use it to support high quality instruction.

Technology as a Tool

Technology can help students reach higher standards both directly, as a resource in the classroom, and indirectly, as a means for strengthening the knowledge and skills of educators, connecting schools to homes, and increasing administrative efficiency.

Improving Teaching and Learning. Studies on the use of technology for classroom instruction point to a range of benefits, including increases in student achievement levels. Students become better problem solvers and communicators. They write more and revise their work more. They tackle and solve more complex problems. Perhaps most surprising to adult observers, the technology itself quickly becomes invisible to students; like pencils and paper, it becomes a tool for accomplishing other purposes. Additional evidence of the benefits associated with technology includes:

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- studies that document marked student improvement in mathematics and science when computers are used to provide concrete visual support for abstract concepts;[1]
- research that shows that the quality of student writing improves significantly when students use a computer writing tool that automatically provides ongoing guidance during the writing process; and[2]
- studies that report dramatic increases in levels of motivation and persistence when technology puts students in control of their learning.[3]

Technology also enables teachers to expand the world in which learning takes place and greatly enrich student learning experiences. Teachers can bring the outside world into their classrooms and obtain instructional resources that go far beyond what a single school or district can provide. Technology in the form of real-time video can even make "field trips" to remote and exotic locations possible. For example:

- through satellite downlinks to schools, hundreds of thousands of students participating in the Jason Project can watch and gather data as a deep-sea submersible explores the ocean floor.
- using the National Geographic Kids Network, students can study local environmental issues and compare data and findings with their peers around the world.
- via the Internet, students will soon be able to visit the Smithsonian Institution's virtual museum from anywhere in the United States, rotate images of artifacts, and even ask questions of exhibition curators.

Teachers can integrate technology into instruction at all grade levels. Examples include the following.

- Interactive software with vivid cartoon animation is helping first graders learn to recognize words and spell them.[4]
- Third-grade students are creating illustrated software manuals on the computer that will guide future third graders.[5]
- Interactive video-based simulations are being used by secondary school students to conduct dissections of frogs.[6]

Whether it assists students in practicing skills, doing a writing project, or conducting a science investigation, technology is effective when knowledgeable teachers make appropriate choices about its use.

Enhancing Professional Development for Educators. Technology can greatly enhance learning opportunities for educators. With portable computers and network access, especially at home, teachers can download curriculum materials, lesson ideas, and assessment items, as well as communicate with colleagues in remote places. In Texas, thousands of teachers are active users of TENET, a statewide network that gives teachers online access to many services including resource teachers and the Internet. A dozen more states have similar statewide teacher networks or are in the process of developing them.

Cable television and videodiscs can bring real-life models of the best classroom teaching practices into colleges of education and schools. Simulation software can help prospective and practicing teachers learn to handle difficult situations. Communications technology can be used to forge stronger

connections among student teachers, mentor teachers in the field, and university faculty by supporting more frequent conversations and problemsolving.

- The University of South Carolina is using simulation software to help teacher education students learn how to work with students with special needs.
- At the University of Wyoming, student teachers are meeting via a compressed video system with their supervising faculty member, collaborating teacher, and clinical supervisor to discuss problems and questions.

Connecting Homes and Schools. Technologies such as voice mail, electronic mail (e-mail), and video play a valuable role in increasing parents' involvement in their children's education. In West Ottawa, Michigan, an advanced voice mail system enables parents to obtain information on homework assignments, weekly lesson plans, and upcoming events. In addition, the district's sophisticated phone system provides every teacher with a direct dial phone number, making it much easier for parents and teachers to stay in touch. In other districts, e-mail is used to strengthen communication between home and school.

In the future, as other forms of technology become less expensive, linkages between homes and schools will expand opportunities for parental involvement in the education of their children and give them greater access to student work. In addition, technology will help increase learning time for students by making school resources accessible from homes.

Increasing Administrative Efficiency. By facilitating communication, providing greater access to information, and saving time, administrative uses of technology can support school improvement and, in some cases, cut costs. From routing buses to purchasing supplies, from storing student records to analyzing test scores, bureaucratic chores can be accomplished more efficiently with technology. The more decentralized a school system is, the more important it is that schools have immediate access to information on budgets, personnel, and students.

Closer to the classroom, technology can help teachers record attendance, maintain student grades, create and revise lesson plans, and prepare annotated report cards. The resulting time and cost savings can free teachers to focus more on curriculum, instruction, and student learning.

Technology can also support more diverse forms of assessment. In Vermont and California, for example, teachers are using scanners to put portfolios of student work onto computer disks.

Making It Happen

The introduction of technology into classrooms and schools will not increase student learning automatically. To enhance learning through technology, education leaders must rethink how schools are organized and rethink curriculum and instruction in the context of ambitious academic standards. Before educators can tap the powers of technology, they and the public must understand what it takes to help all students meet higher standards.

To use technology effectively, teachers and principals must know, for a start, how to use the hardware and software. More importantly, however, they must understand how to use these tools to create valuable learning experiences for students. In the rush to put equipment into schools, school systems have devoted relatively little attention to this side of the equation. States and school districts will need

to think carefully about what is needed in the way of leadership development for administrators, teacher training, and ongoing professional development to ensure that investments in technology actually result in improvements in learning.

The real value of bringing technology into schools is to help students achieve at higher levels and become more active, confident, and motivated learners. To tap this potential, schools must coordinate technology purchases and uses with articulated learning standards and curriculum goals. Schools need support in this process, whether that means giving teachers extra time to collect information, providing a local technology coordinator, or enabling schools to get assistance from local or regional computing centers.

Several states have developed standards for hardware and software purchases which, if kept up to date, could be helpful to schools working to integrate technology with learning goals. Guidance that identifies examples of software appropriate for meeting various state and local performance standards or curriculum guidelines is especially helpful. At the same time, schools will benefit if software designers refer to emerging standards and curricula as guides for the development of educational software.

As teachers gain easier access to the Internet and as resources expand through electronic networking, educators will become better equipped to make choices for their schools. Wise choices about technology take time—time for educators to try different hardware and software, to search for and download information, and to plan for shared use of expensive equipment.

Making Wise Investments

Technology is constantly changing. Not only is hardware improving rapidly, but the entire landscape of information sources is evolving in profound and unpredictable ways. In years to come, will information travel through telephone lines, television cable, fiber optics, satellites, or other still-emerging technologies? Will software be available for downloading from centralized servers? Will issues of compatibility disappear?

State and district officials face an increasingly complex array of choices and questions. They are discovering that to plan effectively today, they need to imagine the technology of tomorrow. If they invest heavily in today's technology, will it be obsolete tomorrow? If they wait, will they be denying students and educators access to powerful tools? There are no simple answers, but there are rules of thumb that offer guidance to those contemplating major purchases of technology.

One is to recognize that technology costs go beyond one-time hardware and software expenditures. Additional, ongoing costs for facilities upgrading, teacher training, telecommunication access, and maintenance and repair must also be factored in.

Another rule of thumb is to develop an ongoing planning process that assumes annual purchases and expenses and a short lifespan—perhaps five years—for most hardware. These are areas in which businesses could offer their expertise to schools.

It is also useful for school districts to hear about ways in which their counterparts address these issues. For example, in Bellevue, Washington, three committees are providing expert guidance to schools that are developing technology programs. One team determines how to retrofit aging schools for new

technology, including installation of new wiring and electrical outlets. Another team reviews technology plans submitted annually by each school, while a third helps district staff plan and design the system to support future expansion.

Planners must also maintain a focus on instructional goals, carefully matching technology to the educational tasks at hand. In some cases, this means recognizing that not all equipment becomes useless when technology advances. For instance, older computers may be useless for browsing the World Wide Web, but they may be well-suited for helping youngsters learn keyboarding skills or simple word processing.

No local school district or state can count on substantial new funding for technology. Increasingly, innovative financing techniques will need to be employed. In Boulder, Colorado, a county-approved bond issue for school modernization and construction was crafted to include $10 million for technology infrastructure and instruction.

Many states are using innovative public-private partnerships to finance the infrastructure costs of statewide telecommunication networks. Iowa is leading the way with a public-private venture that is creating a statewide, fiber optic telecommunications system. The system, already up and running in much of the state, links high schools, state universities, community colleges, and state offices.

In addition, recently enacted federal telecommunications legislation gives a boost to schools by requiring telecommunications carriers, upon request, to provide services to elementary and secondary schools at discounted rates.

Over the long term, financial support must come from reallocation of existing resources, from creative public-private partnerships and consortia for cost-sharing, and, ultimately, from benefits realized in using technology, including cost savings resulting from greater efficiency. For example, state and local leaders can form intrastate consortia to pool funds for developing software tied to overlapping or shared standards. States can also expect reductions in the current $5 billion a year cost of textbooks and supplemental materials as these items become available electronically. Collectively, these different vehicles will help provide schools with the technology they need to educate their students more effectively and efficiently.

Providing Access to Technology

Technology can promote educational equity among American school children by equalizing access to information and high-quality learning experiences. This can only happen, however, if all students and educators, in all communities, have access to technology.

Inside schools, technology must be available in classrooms, not just the principal's office or the computer lab. Moreover, equipment must be kept in working order for access to have meaning. For educators, access may also mean the availability of technology at home—perhaps in the form of small, portable equipment—as home is where most preparation for classes occurs.

Access is not simply a question of where technology goes, but also how it is used. Students who attend schools where there is little technology or where existing technologies are used ineffectively will leave school poorly prepared for employment or higher education. Students who attend technology-poor

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schools and also have no access to technology in their homes will be at an extraordinary disadvantage when they graduate high school.

States have an important role to play in ensuring access to technology and in calling attention to its powerful, educational uses, both for student learning and for professional development. States can hold grant competitions to focus limited resources on technology-poor schools and on schools that have good ideas for using technology to promote learning standards. In addition, states, with gubernatorial leadership, can help local communities mobilize support from all sectors to equip schools with technology and associated infrastructure.

What Governors Can Do

Governors have a crucial role to play as leaders of education reform in promoting a balanced view of the potential benefits of technology and what it takes to realize these benefits. Technology can play a vital role in supporting learning for students and educators, but it cannot compensate for a weak curriculum or an underprepared teaching force. It cannot replace the need for strong leadership for reform at the school, district, and state levels.

Governors can help ensure that expectations for technology are realistic and that investments are wise. They can call attention to the responsibility of government to ensure equal access for disadvantaged students. In addition, Governors can:

- use the bully pulpit to push for a strong link between technology and ambitious, standards-based curriculum;
- keep attention focused on the need to ensure that teachers and administrators make wise choices and effective use of technology to support student learning;
- convene education decisionmakers, technology developers and providers, and community representatives to develop new public-private partnerships to ensure sound planning, access, and effective use;
- acknowledge the cost of retrofitting facilities and building networking infrastructures, and stimulate new partnerships with providers to gain help;
- focus attention on ensuring that the technology needs of all schools, especially those serving disadvantaged students, are met; and
- forge links between technology developers and schools to ensure that products are geared toward ambitious academic standards, are well-supported, and are usable in classroom settings.

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